4th Annual Conference and Expo on **Biomaterials**

February 25-26, 2019 | London, UK

Keynote Forum

Day 1

Gianfranco Peluso, J Biotechnol Biomater 2019, Volume 9
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Cell/biomaterials interaction

The cell/material interaction is a complex, dynamic process in which the cell and the material synergistically influence the fate of the cell. Indeed, both materials intrinsic (i.e. topography, charge, ζ-potential, and contact angle) and extrinsic properties (i.e. surface functionalization, crystallinity, etc.) played a pivotal role in dictating the type and strength of the biological responses (Figure 1). Furthermore, the ability of biomaterials to release bioactive molecules (i.e. resveratrol, fluoride, etc.) expands the possibilities to control cell-cell interactions and/or intracellular signal transduction. Our recent research demonstrated a functional role of charged polymers in altering or supporting the osteogenic differentiation of mesenchymal stem cells (MSCs) through the modulation of the ephrinB2/EphB4 interaction. Indeed, cell-cell signaling pathways that lead to efficient differentiation of stem cells include the interaction of Ephrin ligands (ephrinB2) with Eph receptors (EphB4). For the first time we have shown that high charged polymers can affect the Eph/ephrin interaction between neighboring cells inhibiting the MSCs osteogenic differentiation via the perturbation of the bidirectional signaling. In contrast, low charged polymers modulate the differentiation of MSCs into an osteocyte lineage via cell-cell ephrinB2/EphB4 signaling.

Moreover, we demonstrated that electrospun PCL and PLA nanofibers loaded with resveratrol (RSV) differently modulate DPSCs osteoblast differentiation and inhibit osteoclastogenesis depending on their RSV release kinetics. Our results indicate that the slow and continuous RSV release from PLA was able to modulate both osteoblast and osteoclast differentiation representing a promising material for the preservation of post-extraction integrity of alveolar socket. Taking together, our results highlight that rationally designed materials can give rise to biomaterials able to modulate functional aspects of biological signaling. Furthermore, understanding the mechanisms by which cells respond to external stimuli could be a successful strategy i.e. in cancer therapy, regenerative medicine, etc.

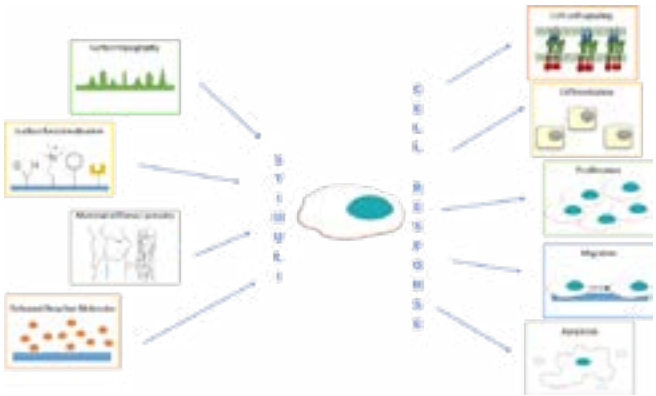

Figure 1: Schematic illustration of cell/biomaterials interaction. Intrinsic and extrinsic materials properties could affect cell fate and tissue development inducing a cell response.

Recent Publications

1. Pannico M, Calarco A, Peluso G, Musto P. Functionalized Gold Nanoparticles as Biosensors for Monitoring Cellular Uptake and Localization in Normal and Tumor Prostatic Cells. Biosensors. 2018 Oct 4;8(4).
2. Riccitiello F, De Luise A, Conte R, D'Aniello S, Vittoria V, Di Salle A, Calarco A, Peluso G. Effect of resveratrol release kinetic from electrospun nanofibers on osteoblast and osteoclast differentiation. Europ Polym J. 2018 Feb 99 289-297.
3. Squillaro T, Cimini A, Peluso G, Giordano A, Melone MAB. Nano-delivery systems for encapsulation of dietary polyphenols: An experimental approach for neurodegenerative diseases and brain tumors. Biochem Pharmacol. 2018 Aug;154:303-317.
4. Conte R, Marturano V, Peluso G, Calarco A, Cerruti P. Recent Advances in Nanoparticle-Mediated Delivery of Anti-Inflammatory Phytocompounds. Int J Mol Sci. 2017 Mar 28;18(4).
5. De Luca I, Di Salle A, Alessio N, Margarucci S, Simeone M, Galderisi U, Calarco A, Peluso G. Positively charged polymers modulate the fate of human mesenchymal stromal cells via ephrinB2/EphB4 signaling. Stem Cell Res. 2016 Sep;17(2):248-255.
6. Calarco A, Di Salle A, Tammaro L, De Luca I, Mucerino S, Petillo O, Riccitiello F, Vittoria V, Peluso G. Long-Term Fluoride Release from Dental Resins Affects STRO-1+ Cell Behavior. J Dent Res. 2015 Aug;94(8):1099-105.

Biography

Prof. Gianfranco Peluso graduated magna cum laude and special mention in Medicine at the University of Naples, Italy. He has been Director of the Department of Experimental Oncology at the National Cancer Institute. Currently, he is Research Director at Italian National Research Council. His scientific activity and areas of interest include: nanoscience and nanotechnology applied to biomedicine, life science and food security, for: a) development of nanostructured polymers as novel delivery platform to minimize drug degradation upon administration, prevent undesirable side effects, and sustain and/or increase drug's bioavailability in a targeted area, and b) synthesis of biodegradable polymers for innovative food packaging to improve shelf life, microbiological safety and sensory properties of foods without affecting their organoleptic and nutritional characteristics.

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Valentina Cauda, J Biotechnol Biomater 2019, Volume 9
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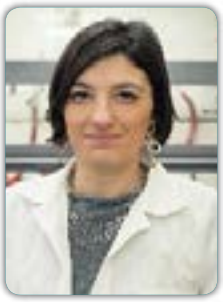

Valentina Cauda
Polytechnic University of Turin, Italy

Hybrid smart nanocrystals and the shielding effect of phospholipid bilayer for biomedical application

Statement of the Problem: Zinc oxide nanocrystals (ZnO NCs), thanks to their unique properties, are receiving much attention for their use in nanomedicine, in particular for therapy against cancer. To be efficiently employed as diagnostic and therapeutic (yet theranostic) tools, highly dispersed, stable and non-toxic nanoparticles are required. In the case of ZnO NCs, there is still a lack of knowledge about cytotoxicity mechanisms and stability in the biological context, as well as immunological response and hemocompatible features. We thus propose a novel approach to render stable, immune and hemocompatible ZnO NCs in various biological media using artificial and natural phospholipidic bilayers.

Methodology & Theoretical Orientation: We synthesized amino-functionalized ZnO NCs, then shielded with phospholipid bilayers either from synthetic origin or natural biovesicles. We characterized their structural, morphological, physico-chemical properties, focusing on the coupling mechanism between ZnO NCs and the lipid vesicles. The stability behavior of different hybrid nanocrystals was evaluated, comparing their biodegradation profiles in different inorganic and biological media. The study aims to investigate how the particle surface chemistry and charge could influence their aggregation/degradation in the different media and interaction with cells. We actually proved their hemocompatibility in human plasma and their internalization into cancer cells and related cytotoxicity mechanisms. A stimuli responsive activation by UV-light was investigated for inducing high mortality of cancer cells based on the hybrid NCs.

Findings: We demonstrated that pristine ZnO NCs strongly aggregate when suspended in both simulated and biological media, showing small dissolution into potentially cytotoxic Zn-cations, also slightly affecting their crystalline structure. In contrast, high colloidal stability and integrity was retained for hybrid lipid-shielded ZnO NCs in all media, accompanied by high biocompatibility, efficient cell internalization and effective killing ability only upon stimuli-activation. These features render these hybrid ZnO NCs ideal "Trojan horses" for further theranostic applications.

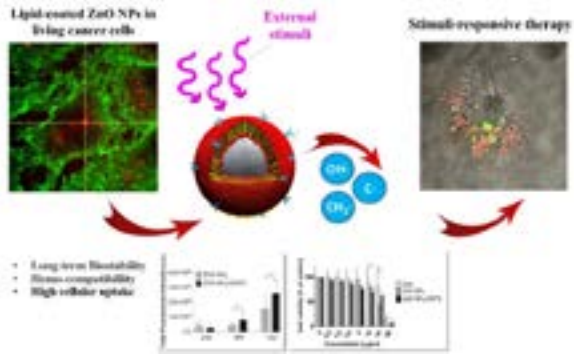

Figure 1: Scheme of the hybrid nanocrystal, as a Trojan horse showing higher bio- and hemocompatibility, long-term stability in various biological and inorganic fluids, improved cell internalization with respect to pristine ZnO NCs. A stimuli responsive behavior, guided by UV-light is also reported.

Recent Publications

1. Racca L et al. (2018) Zinc Oxide Nanostructures in Biomedicine. In Smart Nanoparticles for Biomedicine. Elsevier Pages:171-187. Doi:10.1016/B978-0-12-814156-4.00012-4.
2. Lim E et al. (2015) Nanomaterials for theranostics: recent advances and future challenges. Chem. Rev. 115(1):327-394. Doi:1021/cr300213b.
3. Dumontel B et al. (2017) Enhanced biostability and cellular uptake of zinc oxide nanocrystals shielded with phospholipid bilayer. Journal of Materials Chemistry B 5(44):8799-8813. Doi:10.1039/c7tb02229h.
4. Ancona A et al. (2018) Lipid-coated zinc oxide nanoparticles as innovative ROS-generators for photodynamic therapy in cancer cells.

Biography

Valentina Cauda pursued her PhD in Material Science and Technology (2008) from Polytechnic University of Torino, Italy. She is graduated in Chemical Engineering (2004). She is currently an Associate Professor at the Polytechnic University of Torino. In 2006, she was a visiting PhD student at the Complutense University of Madrid (Spain). From 2008 to 2010, she worked as Postdoc at the University of Munich (Germany). From 2010 to 2015 she was a Senior Postdoc at the Istituto Italiano di Tecnologia (Italy). For her research work she received several prizes: Young Researchers at the University of Munich (2010); the Italian "Giovedì Scienza" award (2013); Zonta Prize for Chemistry (2015) and the USERN Prize for Biological Sciences (2017) respectively. In 2016 she was awarded by the European Research Council with an ERC Starting Grant. She is the author of 84 papers in peer-reviewed international journals with H-index of 28

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Tofik M Nagiev

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New approaches to simulation of enzymatic reactions: mimetic catalysis

The area between enzymatic and chemical catalyses, associated with simulation of biochemical processes by their basic parameters, is accepted as mimetic catalysis. The key aspect of mimetic catalyst is diversity of enzyme and biomimetic function processes, which principally distinguishes the mimetic model from traditional full simulation. Basing on the analysis of conformities and diversities of enzymatic and chemical catalysis the general aspects of mimetic catalysis are discussed. Idealized model of biomimetic catalyst and the exclusive role of the membrane in its structural organization are considered. The most important achievements in the branch of catalysis are shown, in particular, new approaches to synthesis and study of biomimetic catalase, peroxidase and monooxidases reactions. The catalysis direction, originated from simulation of biochemical processes, is suggested to call the 'mimetic catalysis'. Mimetic catalysis designs a real model (a mimic) which simulates objects and processes of enzymatic catalysis by their basic (but deficient) characteristics (selectivity, condition mildness, active site action mechanism etc.). Since only definite properties of enzyme are simulated, it does not pretend to completeness of enzyme description, though optimal parameters by some properties may be approached. The mimetic model of enzyme helps in synthesizing suitable catalysts using inaccurate and sometimes ambiguous information. The overwhelming majority of biomimetics operate in liquid. Their activity depends on the origin of solvents, reaction mixture and cell effects. Gas phase oxidation processes are less dependent on these effects and in the first approximation can be considered as oxidation under quasi-ideal conditions. It goes without saying that enzymatic reactions do not proceed in gases. However, it is possible to simulate catalytic functions in the gas phase. However, it is possible to simulate catalytic functions in the gas phase. This simplifies the decoding of the reaction mechanism, not complicated by factors accompanying the liquid-phase oxidation.

Biography

Tofik Nagiev is a Vice-president of Azerbaijan National Academy of Sciences, Director of Research Center of "Azerbaijan National Encyclopedia" and Department Chief of Nagiev Institute of Catalysis and Inorganic Chemistry of ANAS. He is a Professor of the Department of the physical and colloid chemistry of Baku State University.

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